WINCHELL, N. H.—The Geological and Natural History Survey of Minnesota, Twenty-second Annual Report, for the year 1893. Minneapolis, 1894.

——Annual Report for 1894, Minn. Geol. and Nat. Hlst. Surv. Minneapolis, 1895. From N. H. Winchell.

WOODWARD, A. S.—Notes on Shark's Teeth from British Cretaceous Formations. Reprint Proceeds. Geol. Ass., Vol. XIII, 1894. From the author.

——On a Second Species of Eurycormus. Extr. Geol. Mag., May, 1894. From the author.

——On some Fish remains of the Genera Portheus and Cladocyclus, from the Rolling Downs Formation (Lower Cretaceous) of Queensland.——On the Affinities of the Cretaceous Fish, Protosphyraena.——Extrs. Ann. Mag. Nat. Hist., Vol. XIII, 1894. From the author.

General Notes.

MINERALOGY.[1]

Universal Stage for the Microscope.—Federow has done a great service to mineralogists and petrographers by introducing instruments based on the universal or theodolite principles. His application of these principles to the measurement of crystal angles is the goniometer with two graduated circles, which has already been referred to in these notes. Extending his study to the field of crystallographic-optical measurements, he has devised the universal microscope stage,[2] which increases the usefulness of the microscope by permitting a quite new class of observations to be made. The microscope stage now in use permits of only such motions as always retain the slide in a plane parallel to the initial one. Federow's universal stage allows the slide to be moved into any position whatsoever by two rotations about axes normal alike to one another and to the microscopés axis. He has described and figured two different types of stage, one better adapted to ordinary work and also permitting the slide to be immersed in liquids if desired, while the other has the advantage of greater simplicity and has a convenient arrangement for orienting the slide in its own plane, so that any line (e. g., a twinning trace) may be brought parallel to the immovable axis of the stage. In answer to some inquiries,

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Zeitsch. f. Kryst., xxii, pp. 229-268, pl. 9 (1893).

Professor v. Federow has kindly informed the editor of these notes that he has designed a third and simpler type of stage, specially adapted to petrographical work, which will shortly be described. All these forms can be attached to any of the standard types of petrographical microscopes by screwing to the mechanical stage. They require, however, a special form of slide, which is circular, with a diameter of about 2 *cm.*, and, when in use, this is held in an ebonite holder with circular opening, in which the slide can naturally be given any desired orientation.

Parallel polarized light is used with this stage, and the presence of an axis of the ellipsoid of elasticity in any section is indicated by first bringing the two principal directions of the section parallel to the two axes of the stage and then rotating the slide about each separately. If either of the principal directions is an axis of elasticity, the slide will evidently remain dark when rotated about the axis normal to it, whereas otherwise it will show interference colors. This affords the following scheme for determining the symmetry of a mineral from examination of random sections in a rock slide:

Isometric. Every section is isotropic.

Hexagonal and Tetragonal. Every section has one axis of elasticity.

Orthorhombic. Sections lying in the zones of the three crystallographic axes contain an axis of elasticity.

Monoclinic. Sections belonging to the zone of the axis of symmetry contain an axis of elasticity.

Triclinic. Entire lack of such sections.

Some of Federow's applications of this instrument to the study of the feldspars will be referred to later.

A somewhat different form of stage embodying the same idea, but adapted to the study of the ordinary form of slides, has been since devised by Klein and manufactured by Fuess for attachment to his instruments.[3] Klein[4] has also designed a form of this stage (likewise manufactured by Fuess for his large stand) to be used with convergent as well as parallel polarized light, and this can be used to find the position of the optic axes and measure the optical angle in crystals as well as in sections.

Connection Between Atomic Weight of Contained Metals and Morphological and Optical Properties of Crystals.—The relations found by Tutton to exist between the atomic weights

[3] Groth, Physikal. Kryst., 3d ed., p. 749, figs. 688 and 689 (1895).

[4] Ibiden, p. 750, fig. 691. Cf. also Sitzungsber. d. Akad. d. Wiss., Berlin, 1895, p. 91.

of the contained metals and the crystal characters of the potassium, rubidium, and cæsium double sulphates of formula $R_2M(SO_4)_26H_2O$,[5] have been found by Muthmann[6] to hold also for the permanganates. Continuing his studies Tutton[7] has made an equally exhaustive crystallographic study of the normal sulphates of the same alkali metals. The earlier determinations made on these substances seemed to be in conflict with the facts brought out by Tutton in studying the double sulphates, but after most exhaustive and precise observations with specially-devised apparatus, Tutton is able to show that the recorded observations on these salts are incorrect, and that the intermediate position crystallographically of rubidium is established for this series as well as the other. There is shown to be a progression corresponding to the increase of atomic weight of the contained metal as regards the axial ratio, the size of the interfacial angles, and the molecular volume. The differences in the magnitude of the analogous angles, seems, however, to be less, the higher the symmetry, approaching, Tutton suggests the absolute identity requisite to isometric symmetry. The habit of the crystals seems to obey the same law. In a discussion of the relative linear dimensions of the crystal elements of the Bravais-Sohnche space lattice, is communicated a simple method of determining these values which was suggested by Becke. Becke's formulæ are:

$$a_0 = \sqrt[3]{\frac{a^2V}{c}} \qquad b_0 = \sqrt[3]{\frac{V}{ac}} \qquad c_0 = \sqrt[3]{\frac{c^2V}{a}}$$

in which a_0, b_0, and c_0 (X Ψ Z of Muthmann) are the *relative* dimensions of the crystal element in the direction of the correspondingly named crystal axes; a, b, and c are the unity lengths of the crystal axes; and V is the molecular volume. Tutton proposes to call the distances a_0 b_0 c_0 (Muthmann's *topische axen*) *distance ratios of the crystal elements*, and, as they are only relative values, to make one equal to unity as in the case of axial ratios. When these values are determined for the three sulphates, it is found that rubidium occupies the intermediate position. Tutton also finds that these salts follow the Bravais-Sobnche theory in that the planes of cleavage { (010) most perfect and (001) less perfect } are the planes in which the elementary parallelograms of the lattice system are respectively smallest and next smallest.

The optical study consisted in the determination of the principal indices of refraction in prisms prepared with unusual care by the deli-

[5] See these notes.

[6] Zeitsch. f. Kryst., xxii, p. 497.

[7] Jour. Chem. Soc. London, 1894, pp. 628–717.

cate apparatus described by him before the Royal Society, and also in the measurement of the optical angle (in sections prepared accurately normal to a besectrix by means of the same apparatus) in five different wave lengths of light. Here again the intermediate position of rubidium is proven by the values of the indices of refraction along corresponding crystallographic axes. Rubidium sulphate is found to be quite a unique substance optically, having an *extremely* low double refraction (*small differences* between the indices of refraction), but, in general, a large optical angle (*large relative differences* between refractive indices), with high dispersion of the optic axes due to the fact that differences in the magnitude of $2V$ for different wave lengths are large by reason of the extremely small differences between the indices (low double refraction). Similarly the changes in $2V$ caused by rise of temperature are abnormally large. Further, since the index of refraction along crystallographic c increases with rise of temperature faster than those along the other axes, and more in amount than the difference between the indices along c and b at the ordinary temperature, the result is a closing up of the optical angle with a rise of temperature and an opening out in the plane normal to its first position.

The following figures, which are the ratios of the optical elasticities along the crystallographical axes, tell this story:

$$\text{At ordinary temperature } a : b : c = \overset{\mathfrak{c}}{0.9991} : \overset{\mathfrak{a}}{1} : \overset{\mathfrak{b}}{0.9999}$$

$$\text{At } 180^\circ, \quad a : b : c = \overset{\mathfrak{c}}{0.9993} : \overset{\mathfrak{b}}{1} : \overset{\mathfrak{a}}{1.0006}$$

Somewhat similar changes have been found to occur in heating potassium sulphate, but only at higher temperatures. The many results of this elegant and thorough study can not be given in a review of these proportions, and the reader is referred to the original paper.

Boleite and Nautokite from Broken Hill, N. S. W.—Liversidge[8] describes boleite from Broken Hill, N. S. W., in cubic crystals as much as seven millimetres on an edge and modified by both the octahedron and the dodecahedron. The matrix is hematite and quartz. The mineral has heretofore been found only at Boleo in Lower California. From the same locality the same writer describes nautokite, the lower chloride of copper, in fragments of crystals, and beautiful crystals of cerargyrite and cuprite.

New Minerals from Chili.—The late Dr. Dietze,[9] of Tantal, Chili, a few years since studied chemically several new minerals from

[8] Read before the Royal Society of New South Wales, June 6th, 1894. (Separate.)

[9] Zeitsch. f. Kryst., 19, p. 445 (1891).

the salt pampas of that country. Osann[10] has recently studied three of these minerals crystallographically and optically. Some of his results are summarized below:

Darapskite ($Na_2SO_4+H_2O$, Dietze) from Pampa del Toro near Pampa, where it occurs abundantly with blödite. Monoclinic with axial ratio $a : b : c = 1.5258 : 1 : 0.7514$. $\beta = 77°5'$. Habit tabular parallel to the orthopinacoid. The observed forms were (100), (001), (010), (110), ($\bar{1}01$), ($\bar{2}01$), (101), (302), (011), ($\bar{1}11$), (111), and (121). Twins are common according to (100), and are sometimes polysynthetic. H, 2–3, G, 2.203. Easily soluble in water.

Lautarite { $Ca(IO_3)_2$, Dietze } from Calcium Chloride Pampas, also Pampa del Pique III and in Pampa Grove. Monoclinic with axial ratio $a : b : c = 0.6331 : 1 : 0.6462$. $\beta = 73°38'$. The prismatic crystals show the following forms: (110), (120), (010), (001), (011), (101) and ($\bar{1}01$). Cleavage parallel to (011). The crystals vary from colorless to bright wine-yellow, and are difficultly soluble in water. H, 3–4, G, 4.59 (Dietze).

Dietzite. This mineral occurs in the Chloride of Calcium Pampas, and was determined by Dietze to have the formula $7\ Ca\ (IO_3)_2\ 8\ Ca\ Cr\ O_4$. It has monoclinic symmetry with axial ratio $a : b : c = 1.3826 : 1 : 0.9515$. $\beta = 73°\ 28'$. Crystals tabular according to 100, possessing the forms: (100), (010), (001), (110), (210), ($\bar{1}01$), ($\bar{2}21$) and ($\bar{2}23$). H, 3–4, G, 3.698. Soluble in hot, but only slightly soluble in cold, water. The mineral is named by Osann in honor of the finder, Dr. Dietze, who perished in a snow storm while on a scientific expedition in the Andes. Lautarite and Dietzite are interesting as being the first salts of iodic acid that have been found in the mineral world.

Miscellaneous.—Rinne[11] determines the symmetry of crystals of metallic aluminium to be probably isometric from a study of quite perfect growth forms. Lacroix[12] describes well crystallized epidote from or near Voheimar, Madagascar, which have developed the base, orthopinacoid, the unit positive orthodome, and also (210), ($\bar{1}02$), (011) and ($\bar{1}11$). He also makes a correction to his earlier paper[13] on the pyromorphite of New Calidonia, adding the form ($11\bar{2}1$) and replacing the described forms ($50\bar{5}4$) and ($10.0.\overline{10}.1$) by the forms ($15.0.\overline{15}.14$) and ($90\bar{9}1$). Ussing,[14] in connection with a mineralogical-petrographical

[10] Ibidem, 23, pp. 584–589, pl. 7 (1894).

[11] Neues Jahrbuch f. Min., etc., 1894, II, pp. 1–2.

[12] Bull. Soc. Franç. Min., xvii, pp. 119–120, May, 1894.

[13] Ibidem, pp. 120–121.

[14] Mineralogisk-petrografiske Undersogelser af Gronlandske Nefelinsyeniter og beslaegtede Bjaergarter, by N. V. Ussing, pp. 220, pls. 7, 1894.

investigation of the Greenland nephelene syenites and their associated rocks, describes nepheline altered to cancrinite, sodalite, analcite, hydronephelene, natrolite, and potash mica; also sodalite altered to analcite and natrolite and eudialite altered to katapleite and zircon. Besides numerous varieties of feldspar, augite and hornblende, he describes Ainigmatite and Kölbingite from these rocks. The work is printed in the Danish language.

WM. H. HOBBS.

GEOLOGY AND PALEONTOLOGY.

The Protolenus Fauna.—An important paper based on the collections made by W. D. Matthews, of fossils from the lower part of the Cambrian rocks of New Brunswick in 1892, '93 and '94, was recently communicated to the New York Academy of Sciences by G. F. Matthews. From this article the following abstract has been made of the character of the fauna and the conclusions arrived at from its study.

The fauna described is one of the oldest known. It consists of Foraminifera, Sponges, Molluscs and Crustaceans. All the Foraminifera described are referred to the genera Orbulina and Globigerina; the Sponges include Protospongia and others. The Molluscs are mostly hyalithoid shells of the genera Orthotheca, Hyolithus and Diplotheca. The Crustaceans are chiefly of the two groups, Ostracoda and Trilobita, of which the former are remarkable for the large number of genera and species, as compared with the trilobites; two predominant and characteristic genera are Hipponicharion and Beyrichona. All the trilobites are of genera peculiar to this fauna, except Ellipsocephalus, which, although one of the dominating types, also occurs in the Paradoxides beds of Europe. The most characteristic genus of trilobites is Protolenus, which is abundantly present in the typical beds.

The following are some of the salient characters of the fauna as at present known: *All the trilobites have continuous eye-lobes.* This is decidedly a primitive character, and its value in this respect is shown by the genus Paradoxides of the overlying fauna, which began with small species having such eye-lobes, and culminated in the large forms of the upper Paradoxides beds in which the eye-lobe was considerably shortened.

The important family of Ptychopariidae is absent.